7 BASELINE DEVELOPMENT AND VALIDATION

7.1 OVERVIEW

Each project shall have a formally approved and communicated baseline that describes the integration of the technical objectives and requirements with the schedule and cost objectives. The baseline is included in the Project Execution Plan. At Critical Decision CD-1, Approve Preliminary Baseline, a preliminary baseline range will be adopted by the project until it is replaced by the performance baselines at CD-2, Approve Performance Baseline. The scope (technical), schedule, and cost processes are the three key elements used to establish an integrated approach to project baselines.

The five principle reasons to establish baselines documents are to

- ensure attainment of project objectives.
- manage and monitor progress during project execution.
- define the project for approval and authorization by the DOE, by the Office of Management and Budget (OMB), and by Congress.
- ensure accurate information on the final configuration (as-built drawings, specifications, expenditures, etc.).
- establish performance measurement criteria for projects.

Development of the baselines begins with the planning cost, schedule estimates, and the preliminary scope included in the Justification of Mission Need and is further defined in conceptual design documents. All capital asset projects will be required to have their baselines independently certified through an independent cost estimate (ICE) review which addresses the technical, schedule, and cost baselines.

All DOE capital-asset projects, irrespective of funding type, will be reviewed as part of the annual budget validation process. A tailored approach will be used to assess readiness to proceed and the ability to use planned funding. General plant projects, capital equipment projects, and operating expense-funded projects that

are $5M or less are the validation responsibility of the operations or field office managers. The DOE Controller (CFO) will issue DOE project validation guidance annually through the Budget Call for the coming year.

Program Secretarial Offices (PSOs) are responsible for conducting all project ICE baseline verifications/validation reviews including Major Systems. The PSOs may delegate project validation responsibility to operations or other field offices.

Where delegated, field offices will supply the appropriate Headquarters program validation coordinator with a list of all projects proposed for annual budget validation, a formal report in the format specified in the annual Budget Call and signed by the validator should be submitted to the Headquarters program office for formal concurrence and submittal to the CFO.

7.2 PURPOSE

A project baseline describes a desired end product and associated schedules and costs.

Project baselines should be reaffirmed at each major decision point and at "critical decisions" for major systems. For other projects, reaffirmation should occur at the equivalent decision points, especially prior to the commitment of significant resources. In addition, baselines should fit into the Congressional budget cycle to ensure that the information submitted is accurate and current.

The level of detail involved in developing a project baseline depends on the nature of the project. A tailored approach should be used commensurate with

- the size and complexity of the project.
- the uniqueness of the project, the use of new versus proven components and processes, and project visibility and sensitivity.
- the extent to which the activity is already covered by contractual requirements and other risks.

The tailored approach is used to ensure that excessive, inefficient, and inappropriate management requirements are not imposed on a project. Large and complex projects (i.e., major systems) usually require highly developed baselines. Smaller projects usually require lesser detail.

Once a site develops, its project integrated baseline, the OECM, working with the site, is responsible for ensuring that the life cycle site baseline is independently

reviewed and validated to prove that it is defensible relative to scope, schedule, and cost. A credible and independent review of each site's baseline is an expectation of Congress, OMB, local stakeholders, Tribal Nations, and the DOE. Baseline verification (validation) is a one-time event. Once a baseline is verified (validated), it should not generally require revalidation if changes are managed through a rigorous change control process. Completion of a rigorous independent verification review should reduce the need to subject the site to additional resource-consuming audits, and reviews by other organizations. This independent life cycle baseline verification review is not to be confused with the budget validation that is conducted by the field organization during the annual budget formulation process.

7.3 APPLICATION

7.3.1 Baseline Development

A project baseline contains three elements:

- the scope (technical) baseline
- the schedule baseline
- the cost baseline.

The scope (technical) baseline is developed first and describes the desired configuration, performance, and characteristics of the end product. The scope of work necessary to provide the end product is determined using the technical baseline. The scope of work is divided into elements that become the work breakdown structure (WBS). The scope is the basis for the schedule and cost baselines. These three baselines are tightly coupled, and a change in one baseline generally affects one or more of the others. The WBS itself is hierarchical in the sense that each element in a WBS may be subdivided and becomes the basis for the next lower, more detailed WBS level.

Initially, few details appear in the baseline. It may include only the performance directly related to program mission, some bare specifications, and an outline of the technical approach. During concept development, details are added, including end product and critical subsystem specifications and drawings. For environmental cleanup, the initial performance and specification details will focus on cleanup standards, requirements, and the regulatory and compliance drivers involved.

The technical baseline is the reference set of high-level technical documents that contain the technical requirements necessary to satisfy mission needs. The schedule baseline is the set of approved milestones derived from, and consistent with, the technical logic. The schedule milestones are traceable to elements within the WBS. The cost baseline is developed by allocating resources and estimated costs against the scheduled activities for the total scope of work. The cost baseline supports the technical work scope, is traceable to the WBS, and is time-phased and aligned to the schedule baseline and mission elements.

Baselines are controlled through the application of the configuration management and baseline change control processes, and will evolve as the project matures.

Baseline details and precision increase as a project progresses. For a conventional construction project, phases may include concept development, preliminary design, detailed design, and construction. Project engineering and design (PED) funds become available for the preliminary and final design and baseline development. Projects with a Total Project Cost (TPC) of $5M or more, require an external independent review (EIR) verification of mission need and baseline. For environmental restoration, this is usually assessment and design. During early project phases, baseline development may, if schedules or costs do not meet expectations, require redetermination and rescheduling of the technical baseline or scope of work. During operations and project closeout, there is seldom any change to the baseline or the level of detail.

7.3.1.1 Scope (Technical) Baseline Development Process

The scope (technical) baseline development process requires management actions necessary to formally establish the project mission, functional objectives, design or characterization requirements, and specifications in order to define, execute, and control the project scope of work (Figure 7-1). The technical requirements are the basis for development of the project's WBS, cost estimate, schedule, and performance reports.

The contractor must establish a scope baseline from which work can be accomplished and performance measured. The contractor scope baseline is developed after the project's mission, technical objectives, and functional requirements (or equivalent objectives such as environmental assessment requirements) are established by the project manager and included in the project documentation, e.g., PMP. The formally approved technical objectives and requirements are baselined at Critical Decision 1 (DOE approval of conceptual design or equivalent report such as an assessment work plan for environmental subprojects). The scope

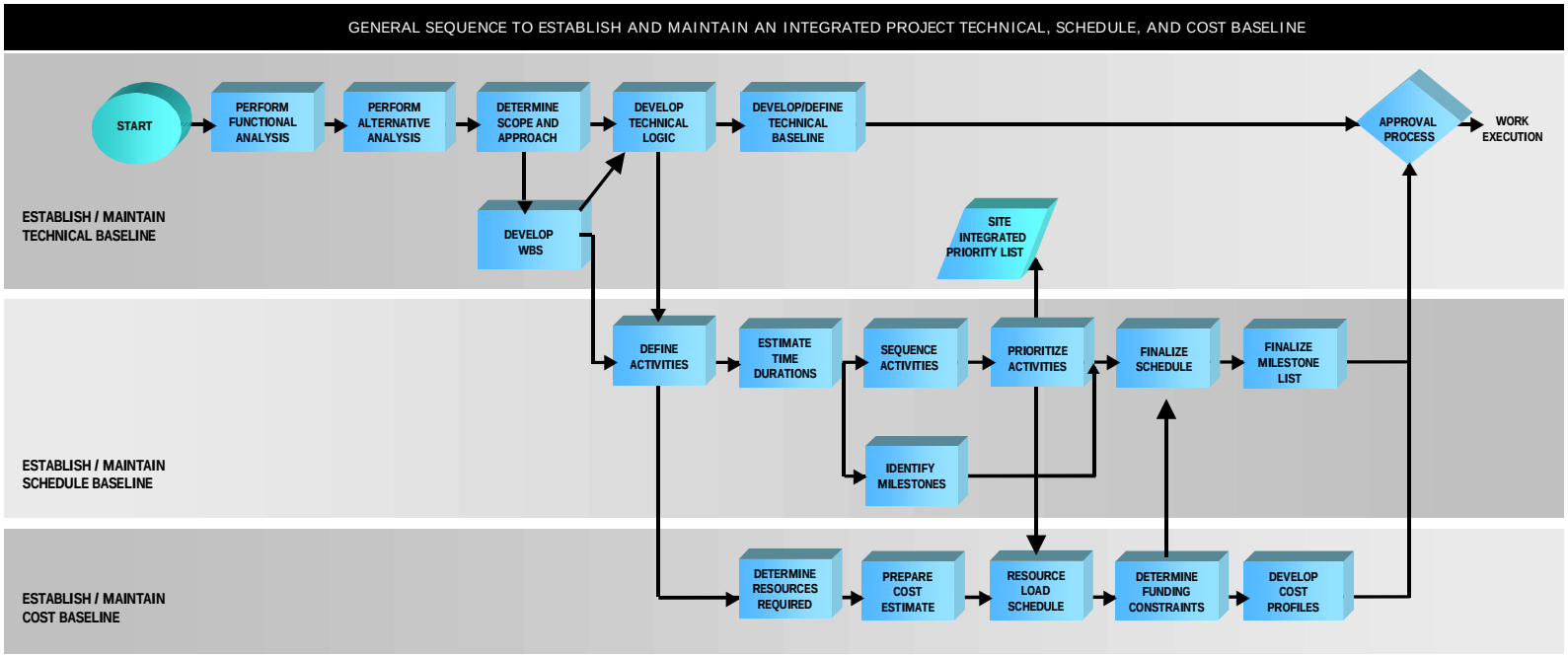

Figure 7-1. Scope (Technical) Baseline Development Flowchart

(technical) baseline and work scope definition guideline requires that the contractor scope baseline be contained in formal documentation, such as a conceptual design report or an environmental cleanup work plan, and be approved by the DOE. This is the point from which technical aspects of the contract work will be subject to formal change control.

All authorized project work shall be defined in a Work Breakdown Structure (WBS) that represents the way the work will be estimated, scheduled, budgeted, performed, and managed. The WBS shall be maintained consistent with project needs throughout the life of the project, ensuring changes to the WBS are made within a formal change control process.

All projects should have a clearly defined work scope to accomplish the DOE prescribed scope baseline. The work scope must be described in sufficient detail to ensure that functional design requirements, major physical attributes, and performance characteristics are clearly accomplished.

Project risk factors must be considered when developing the WBS. The primary purpose of the WBS is to divide and organize work into manageable sized units. Requiring added levels of the WBS will in turn require a further division of the work into progressively smaller units, which may be required on more complex projects of higher risk.

The scope baseline must be established such that scope performance can be measured and controlled throughout the life of the project. Monitoring and controlling scope performance involves tracking the achievement of the scope baseline at the contractor level. The scope baseline must be hierarchically related such that monitoring scope performance at the contractor level is related to the accomplishment of higher level (DOE-controlled) baselines pertaining to the objectives and mission of the project. The scope baseline must also relate to the schedule and cost baselines to allow scope performance monitoring to correlate with cost and schedule monitoring.

Changes to the WBS should not be made once work has started, although sometimes changes are necessary to make corrections. Some WBS changes, such as splitting work scope into multiple WBS elements, may cause a significant disruption to the project control system if some of the work has already been performed and actual costs incurred. Changes to the WBS normally result as a project progresses through its phases such as design, procurement, construction, test, operation, etc.; and when project re-scoping occurs. An example of expected changes to the WBS would be the expansion of WBS elements as future work becomes more definite “or” the aggregation of the WBS elements in the same leg of the structure if less detail is required to effectively manage the work.

The work defined in the contract scope of work and subsequently organized in the WBS should be assigned to the specific cost account managers in the organizational elements that are responsible for managing and performing the work.

The cost account manager(s) should be identified as early as possible to permit participation in the planning and scheduling process. The schedule that is developed for performing the work should have the involvement of the responsible cost account manager. The schedule developed by the cost account manager will define the work approach and sequencing with activity logic, and identify the resources estimated to complete the work within the activity durations assigned. The project must have the cost account manager assigned before the work starts.

7.3.1.2 Schedule Baseline Development Process

When establishing the schedule baseline all known requirements affecting a project must be identified and considered in the development of project baselines, and all project work is scheduled using a disciplined, integrated approach.

Schedules shall be developed that are consistent with the WBS and integrated with the cost estimate, and shall represent all project work scope regardless of funding source. Activity logic will be developed to depict all work scope, constraints, and decision points. Time durations will be estimated and assigned to activities representing work accomplishment. Development of schedules must be in concert with the WBS such that all work is represented in the schedule, and accurate durations are established.

Schedule activities should be traceable to the cost estimate and the WBS. Schedule activities, durations, and sequencing relationships are conceptually developed in conjunction with the development of the project cost estimate. The cost estimate is generally calculated below the lowest level of the WBS and provides one means for estimating activity durations.

Activities and logic should be planned by WBS element first, to permit the checking of activities and logic with the WBS element scope of work and technical requirements. After determining that adequate activity planning against the WBS element has been accomplished, the integration of activity logic between WBS elements is performed. Logic links must be developed thoroughly enough to allow an accurate critical path to be calculated in order to serve as the basis for forecasting and decision-making throughout the life of the project.

A tailored approach should be used when determining how much detail will be included in the schedule. Basic guidance for determining the extent of activity detail is that the number of activities should not be so few as to prevent suitable progress tracking, and not so numerous that the number of activities overwhelms the system and its users, rendering the schedule logic incomprehensible and too burdensome to status.

An approved schedule baseline must be established that clearly depicts critical path activities and milestones from which actual performance for all activities and milestones can be compared, and from which forecast data can be generated. Resource-loaded activities, as required and at the appropriate level, will be used to develop time-phased budgets that are integrated with the schedule. Only approved changes to the schedule baseline will be permitted.

Project schedule activities (not milestones) should be resource-loaded to facilitate analyses of "what if" funding scenarios. Resource-loaded schedules assist the Project Manager and the contractor in developing time-phased budgets and spending profiles. On projects using critical-path method schedule networks, schedules should be resource-loaded at a summary level; resource-loading within the same scheduling database is desired but not required.

Where logic relationships are established, the detailed level of the schedule, is the focal point of a project's scheduling system from which all scheduling reports are generated. The detailed critical path schedule is normally contained in a database that can be coded, sorted, or summarized to produce higher level schedules and specialized scheduling reports. Having the capability to selectively produce different types and levels of project schedule reports and graphic plots adds to the flexibility.

Technically significant events, such as design review completions, delivery of major equipment, regulatory or interagency commitments, etc., should be considered in developing milestones. Milestones should be selected with consideration given to the critical path.

Milestones are much like schedule activities in that too many may become unmanageable, and too few may not provide the required visibility. Milestones should be meaningful and should be selected at time intervals that will allow a consistent and thorough depiction of project progress. Milestones are an integral part of the project schedule database and are reportable to varying accountability levels. To allow traceability through the WBS from higher levels to lower levels, milestones that are contained in the schedule database should also have logic links to activities as appropriate, and should be coded to roll up to selected WBS levels.

All known project and contract requirements, major procurements, milestones, and constraints must be identified for the planning and scheduling process. Activities external to the project that could reasonably be expected to impact the project must also be considered. All project work must be scheduled using a formal, documented, consistent approach. The schedules should reflect planning by the appropriate technical expertise as to how the activities will be accomplished. The initial schedule from which performance will be measured, developed at CD-1 (or an environmental clean up work plan), establishes the project schedule baseline which includes project milestones. Modifications to the schedule baseline are subject to formal change control.

Establishing milestones at the different levels of management control creates an integrated milestone hierarchy. That is, the lower-level milestones should be established to help measure schedule performance and to support upper-level milestones. The measurement of progress toward completing a high-level milestone is important and can be done with reasonably spaced lower-level milestones that depict interim schedule assessments. The range (or roll-up) are low-level schedule and milestone tasks that support master schedule and milestone lists.

7.3.1.3 Cost Baseline Development

Cost baselines are developed to ensure that budgets for labor, services, subcontracts, and materials are established at the proper levels and are "time-phased" in accordance with the project schedule. This ensures that the Total Project Cost (TPC) is noted within the system and that the project direct costs and indirect costs are identified and managed.

Developing a cost account structure that integrates with the WBS and facilitates the collection of expense and capital costs by organization and cost element, as appropriate, establishes a process for controlling the opening and closing of cost accounts for the life of the project.

Each cost account must have scope, schedule, and budget. That is, budget must be estimated for the scope of work contained in the account, and must be time-phased in accordance with the project schedule. Time-phasing of the budget in accordance with the schedule may be accomplished manually by the cost account manager, or with a resource-loaded schedule network for complex projects. Time-phasing of the resource requirements must be performed in a way that represents the way the resources will be accounted for when costs are incurred. The basis for the budget that is time-phased in the control account must be supported by, and reconcilable to, the cost estimate and schedule.

All work must be represented in cost accounts, and the sum of all cost account budgets, contingency, reserves, and fee, equals the TPC or contract value, as appropriate.

A project's cost baseline is a budget that has been developed from the cost estimate and has been timed-phased in accordance with the project schedule. The cost baseline is referred to as a baseline since it is subject to formal monitoring and controls, and is integrated with the technical and schedule baselines.

When combined with other cost baseline components, form budgets with unique purposes as listed below:

1. When added together, the sum of all cost baseline components for all contracts equals the TPC.

2. The sum of the direct, indirect, contingency and management reserve, and undistributed budget equal the total dollar amount allocated for the project/ contract scope of work.

Project cost and schedule baselines shall provide the basis for multi-year work planning. These baselines will also be used to generate annual budget cycle products including Project Baseline Summaries (PBSs), project data sheets, funding requests, Paths to Closure data, IPABS-IS data sheets, and so forth.

7.3.1.4 Baseline Change Control

Once the technical, schedule, and cost baselines are clearly defined, documented, and approved (CD-1 Preliminary Range and CD-2 Performance Baseline), they must be controlled by a formal and documented control management process. Project baseline changes will experience the need to have various levels of approval authority. Contractor-level baseline changes may be made by the contractor without DOE approval, but the changes will be documented and provided to DOE for information on a regular periodic basis as defined in procedures and stated in the Project Execution Plan (PEP).

Contractors and DOE should process and implement change requests in a timely manner. Contractors should not allow changes to performance data (cost plan, earned value, costs, or schedule) that have not been recorded and reported for completed work. The only exceptions are to correct errors and to make accounting adjustments. Contractors may internally re-plan future work when the re-plan will result in more efficient or effective ways to perform the work as long as no DOE milestones are unfavorably impacted or additional budget is required.

Internal replanning must be coordinated with and approved by the project manager. Such re-planning is included in the next regularly scheduled project report.

7.3.2 Project Baseline Verification (Validation)

Baseline external independent reviews are to be conducted by personnel that are recognized as qualified in their respective fields of expertise and are outside the project organization. These reviews assess the reasonableness of the technical approach and project scope, schedule and cost baselines, and also assess the potential for schedule and/or cost improvement. The timing and scope of independent baseline reviews will depend on the type of project and the baseline element (technical, schedule, cost) being considered. An independent review of technical requirements, technical approach, and scope of a new project should be conducted before the baseline schedule and cost estimate are developed, while technical, scope, schedule and cost will all be reviewed at the same time for subsequent reviews or for a baseline change package. The need, frequency, and depth of each review will be established by considering minimum requirements for conducting specific reviews or by using a tailored approach to consider the maturity of scope definition, the nature of the activities being reviewed, and the risks associated with the baselines. All projects having a TPC greater than $5M must have an independent baseline review prior to receiving CD-2.

The OECM will select the validation organizational team. A team or organization that is clearly independent of the business implications of the validation results will conduct the independent baseline validation. For example, Headquarters Site Team members or Operations Office staff should not participate in the independent validation for their assigned sites, although they may participate as observers. The verification/validation team or organization should not have contributed to the development of the baseline or project planning documents, nor should it experience any positive or negative effects from the validation finding. Independent baseline reviews will focus (1) on satisfying technical mission requirements and (2) the reasonableness and validity of the baseline cost and schedule; by using appropriate estimating techniques and comparisons to benchmark costs where applicable. The outcomes of the review must be discussed, negotiated, and then incorporated into the project baseline through the change control process.

Independent baseline reviews are those used to verify the completeness and reasonableness of cost and schedule baselines and any other estimates or schedules used to analyze project alternatives or support management decisions. These reviews (1) are typically performed before approving the cost and schedule infor-

mation for use to support budgetary document or management decisions and (2) should be thoroughly documented for future reference.

Annual project budget validation usually applies to all line-item construction or capital asset projects. It is the formal process of evaluating project planning, development, baselines, and proposed funding before including projects or system acquisitions in the DOE budget. Validation requires a review of project planning and conceptual development documentation; as well as discussion with the program or field element and principal contributing contractors, to determine the source basis, procedures, and validity of proposed requirements, scope, schedule, cost, and funding. Findings and recommendations resulting from the budget validation process will be provided for use in formulating the annual budget. Specific guidance for conducting budget validations is provided annually by DOE-HQ.

The independent baseline review and validation processes are not intended to replace or duplicate the peer review processes and procedures of each contractor. Thorough and effective peer review, using personnel either internal or external to the contractor organization, is essential to ensuring that all project baselines and baseline change requests submitted to DOE are reasonable, complete and accurate, and can withstand an independent review.